724-02: BACKGROUND ON DROUGHT

02-01 Background on Drought

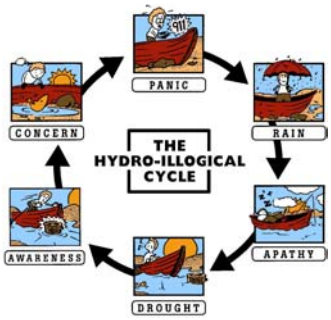
Generally, drought is characterized as a continuous period of time in which rainfall is significantly below the norm for a particular area. The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. A drought is a natural hazard that differs from other natural hazards in that it is not something that occurs suddenly. Rather, a drought evolves over months or even years and, while causing little structural damage, can have profound economic, environmental, and social impacts.

The abilities of the state to withstand the effect of droughts are dependent upon numerous factors. The primary use of water in Rhode Island by the general population is for domestic uses, sanitation and drinking water. The vulnerability of the state to drought is increasing as water use increases. People tend to assume that plentiful water is the norm for Rhode Island, when, in fact, occasional droughts of at least moderate intensity and duration have occurred here. Drought can have wide-ranging effects but, unlike fast-moving natural disasters, such as hurricanes or blizzards, drought as a disaster lacks drama. Though droughts give plenty of warning, the perception of drought's consequences by the average person may only occur when they directly affect him or her. Figure 724-(1), the Hydro-Illogical Cycle from the National Drought Mitigation Center illustrates how little the average person thinks about drought until directly impacted by it.

The impacts of drought span economic, environmental and social sectors. According to the National Drought Mitigation Center, the impacts of drought typically cost the taxpayers of the United States at least as much as other disasters. Drought takes a heavy toll on farm families, the environment, and other areas. During severe droughts, streams and rivers can dry up, affecting wildlife habitat, recreation, and major users dependent upon adequate flow within watercourses (e.g., power generation, sewage treatment systems.) Certain shallow private or community wells could dry up or begin drawing salt water (in coastal communities) as groundwater levels drop, presenting health hazards. Ponds and streams that are used for fire fighting could dry up, increasing fire risks and response times as rural fire fighters seek alternate water sources.

In addition, droughts can raise conflicts between competing interests. For instance, while farmers may seek to increase groundwater withdrawal to maintain their crops, the increased groundwater withdrawal could adversely affect wildlife habitats or the water needs of other well users. Agriculture is often the first to be affected, with drinking water supplies for animals and irrigation sources drying up, affecting livestock, and crops.

Figure 724-(1)
The Hydro-Illogical Cycle



Source: National Drought Mitigation Center

Economic impacts can result from a drought itself or, more indirectly, through conservation measures implemented because of a drought. Farmers can lose livestock or crops or pay substantially more to produce a year's crop. Water suppliers may lose income if they impose restrictions or face increased costs for developing alternate water supplies. Economic impacts to industries can include loss of production due to use restrictions or increased costs for alternate water supplies (e.g., for cooling). Rhode Island relies heavily on tourism. Use restrictions on water dependent uses at beach communities, and restrictions on fishing and canoeing in rivers or on golf courses could reduce the state's appeal to visitors causing reduced revenues from tourism. Drought's impacts can be moderated through mitigation planning and preparedness. Because droughts are a normal part of any climate, it is important to have a plan in place providing for response actions.

02-02 Drought in Rhode Island

Under normal conditions, the State of Rhode Island can be considered a water-rich state. According to the Department of Environmental Management world-wide-web page, Rhode Island enjoys an abundance of water resources that support vital uses such as drinking water, recreation, habitat and commerce, among others. The state has approximately 1,383 miles of rivers, 21,800 acres of lakes and ponds, and approximately 15,500 acres of freshwater swamps, marshes, bogs and fens as well as close to 72,000 acres of forested wetlands. Estuaries, including Narragansett Bay and various coastal ponds, cover one hundred and fifty square miles. Underlying the state are twenty-two major stratified drift aquifers as well as usable quantities of groundwater in almost all other locations from bedrock aquifers.

According to the National Weather Service, the state receives, on average, between thirty-nine inches (on Block Island) to fifty-four inches of rain (in Foster) annually. In contrast, the average annual precipitation for the United States is 29.53 inches. Even though the state receives more rain annually than the average for the United States, Rhode Island does experience extended periods of dry weather. Summer dry spells, during which crops and lawns may require irrigation, are fairly common. Droughts, while less frequent, do occur.

Past planning efforts, including the two previously adopted state guide plan elements dealing with water supply policies and the water emergency response plan, did not directly address specific measures to be taken in the event of a drought. Consequently, prior to the creation of this *Drought Management Plan,* there was no mechanism for coordinating responses to drought by water suppliers throughout the state because of the decentralized nature of water suppliers and the variability of water supply sources. According to the Rhode Island Water Resources Board, there are thirty-one major municipal and private water suppliers that provide water for approximately 90% of the population of the state. Figure 724-(2), Areas Served by Major Public Water Suppliers, shows generalized areas currently served by major public water systems and their source of water.

Unlike some states, Rhode Island has not developed a systematic regulatory procedure for the allocation of water on a statewide or regional basis. Water allocation is currently based on riparian rights, traditional usage, and *ad hoc* permit approvals. Each water supplier imposes use restrictions when necessary based on the limitations of their system. Generally this has worked because water supply has traditionally exceeded demand throughout most of the state's history. However, when drought conditions occur, shortages develop which may affect water suppliers and individual wells (private or community) differently because of regional hydrology, water demand, differing water supply sources, and infrastructure. For example, southern Rhode Island relies on extensive groundwater aquifers for water supply, while much of the rest of the state relies on surface water reservoirs for water supply.

According to *the* Rhode Island Department of Environmental Management's Section 305(b) *State of the State's Waters Report,* approximately two-thirds of Rhode Island municipalities utilize groundwater from public and/or private wells for all or a portion of their water supply needs. It is estimated that twenty-six percent of Rhode Island's population (roughly 262,000 people) depends on groundwater for domestic water use. Domestic water use includes water for normal household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets and watering lawns and gardens. In 1999, there were six hundred and seventy-one public wells in Rhode Island according to the Rhode Island Department of Health, Division of Drinking Water Quality. One hundred and sixty-eight of these wells are community wells, which serve residential populations of twenty-five persons or more. The remaining five hundred and three wells are non-community wells that supply schools, places of employment, hotels, restaurants, etc. It is estimated that there are an additional 112,000 people served by an on-site water supply source.

Figure 724-(2)
Areas Served by Major Public Water Supply Districts

02-02-01 Short-term Droughts

Short-term droughts occur as single season events and involve a summer of less than normal rainfall. Short-term droughts may have brief periods of extremely dry and hot weather, but they do not extend from one year to the next. The amount and the timing of precipitation received are key indicators of an impending drought according to the National Weather Service. Under normal conditions, the United States Geological Survey states that late fall and winter precipitation recharges ground water and stream systems prior to the green-up period in the spring. Short-term drought episodes in Rhode Island usually commence just after the spring green-up period, reaching their greatest intensity during the mid-summer and early fall. The data of the National Weather Service indicate that the short-term droughts of the 1980's and the 1999 drought were preceded by precipitation during the spring that was not sufficient to replenish the deficit from the lack of snow and rain during the previous winter and late fall. The amount of preceding fall and winter precipitation is critical to the evolution and intensity of all drought episodes.

A classic short-term drought occurred during the spring and summer of 1999. The rainfall recorded in June of 1999 by the University of Rhode Island, Department of Plant Sciences was only 0.05 inches. This was the second driest June ever recorded in one hundred and twelve years. The rainfall shortage caused duress for agricultural water users and many other water users dependent on groundwater. Several public water systems whose supplies were dependent on groundwater responded with water use restrictions. Many shallow private wells went dry. According to the United States Geological Survey Rhode Island Office, streams in the state set record or near-record low flows. During this time, the Department of Plant Sciences, University of Rhode Island noted that the Kingston area received 4.01 inches of rain, but lost 5.57 inches to evaporation. In contrast, the largest public water supplier (Providence Water Supply Board) that relies on surface water reservoirs for water supply reported no supply problems in 1999.

02-02-02 Long-term Droughts

Long-term droughts may involve several seasons and/or years of lower than normal precipitation. The National Weather Service has documented that historical long-term droughts have begun with lower than normal precipitation during the preceding fall and winters and evolved into major drought status in the summer. Extended droughts, though not common, require statewide monitoring of climactic conditions. Table 724-(1), Rhode Island Historical Droughts, is based on information from the United States Geological Survey. The table shows that some type of drought occurs about every eleven years in Rhode Island. Rhode Island has had at least six major droughts since 1929.

Table 724-(1)
Rhode Island Historical Droughts

Date	Area Affected	Remarks
1930-31	Statewide	Estimated stream flow about 70% of normal
1941-45	Statewide Particularly severe in the Pawtuxet and Blackstone Rivers	Estimated stream flow about 70% of normal
1949-50	Statewide	Estimated stream flow about 70% of normal
1963-67	Statewide	Water restrictions and well replacements common
1980-81	Statewide Groundwater deficient in eastern part of State	Considerable crop damage in 1980
1987-88	Southern part of State	Crop damage, $25 million

Source: United States Geological Survey

For the major historical drought events, the National Weather Service noted that the precipitation during the preceding fall and winter months was below-normal to much-below-normal which is typically defined as ninety and seventy-five percent less than normal precipitation. Precipitation continued at below normal to much-below-normal levels through the spring and led to the most severe drought episodes, including the 1965-67 long-term drought. The 1965-67 drought episode lasted for three summers and included long periods of below-normal precipitation through the winter, spring, and summer months. This drought period serves as the classic model of a long-term drought in Rhode Island. Though short-term droughts, such as 1999, may not pose a significant impact for the state's public water systems, no water system will be immune to periods of long-term drought.

Historical data for the meteorological conditions present during the 1999 short-term drought is included in Appendix B, Historic Meteorological Data for reference. Included are the monthly historical precipitation rates and yearly averages for the Providence and Kingston weather stations recorded between 1889 and 2001 by the National Weather Service. Also included are the levels of the Scituate Reservoir recorded from 1928 to March 2002 by the Providence Water Supply Board and the Rhode Island 2002 groundwater levels from the United States Geological Survey. This information should be used to calculate and set the base normal conditions for future monitoring of droughts in Rhode Island.